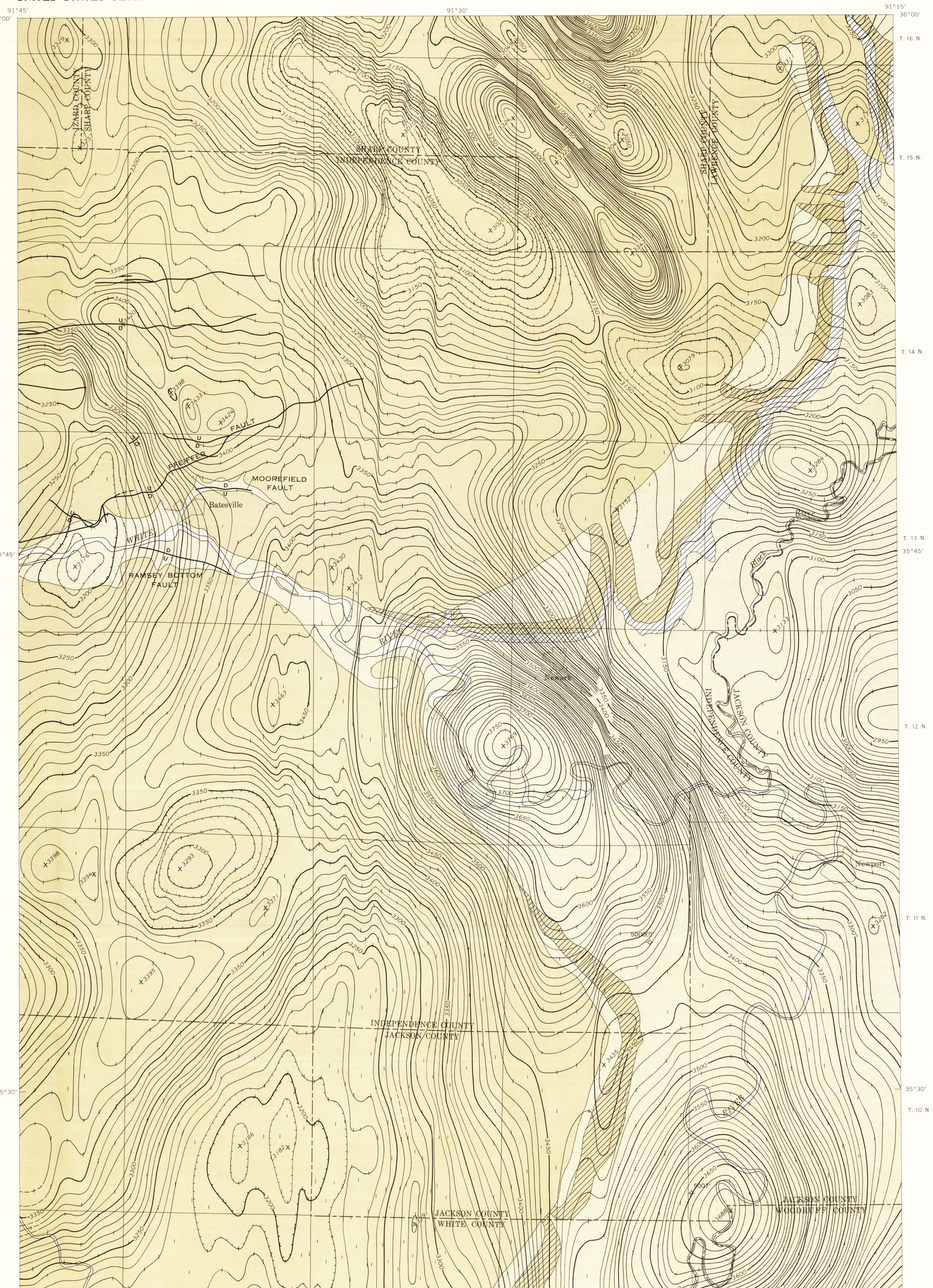


Culture from U.S. Geological Survey topographic maps of Strawberry, Newport, Augusta, and Bald Knob 15-minute quadrangles; from U.S. Geological Survey Bulletin 921–A, east half of plate 1; and remainder adapted from county highway maps of the Arkansas State Highway Commission

Aeromagnetic survey by W. J. Dempsey, 1950. Geologic base map principally from Stephenson and Crider (1916, pl. 2).

EXPLANATION

Quaternary

Tertiary

UNCONFORMITY

Cretaceous

UNCONFORMITY

Paleozoic

Contact

Fault

U, upthrown side; D, downthrown side. *Faults in Batesville area from Gordon and Kinney, 1948, Stracsek and Kinney, 1951, and Miser, 1941. Probable, approximately located, and concealed faults are differentiated on the source maps*

Dry hole, stratigraphic test, or drilling well, showing depth

On figures 2 and 3 the upper figure shows depth to Midway Group; the lower figure or a single figure shows total depth

Magnetic contours showing total intensity magnetic field of the earth in gammas relative to arbitrary datum

Hachured to indicate closed areas of lower magnetic intensity; dashed where data are incomplete

Measured maximum or minimum intensity within closed high or closed low

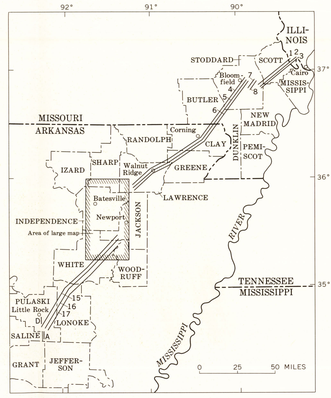
Flight path

Showing location and spacing of data

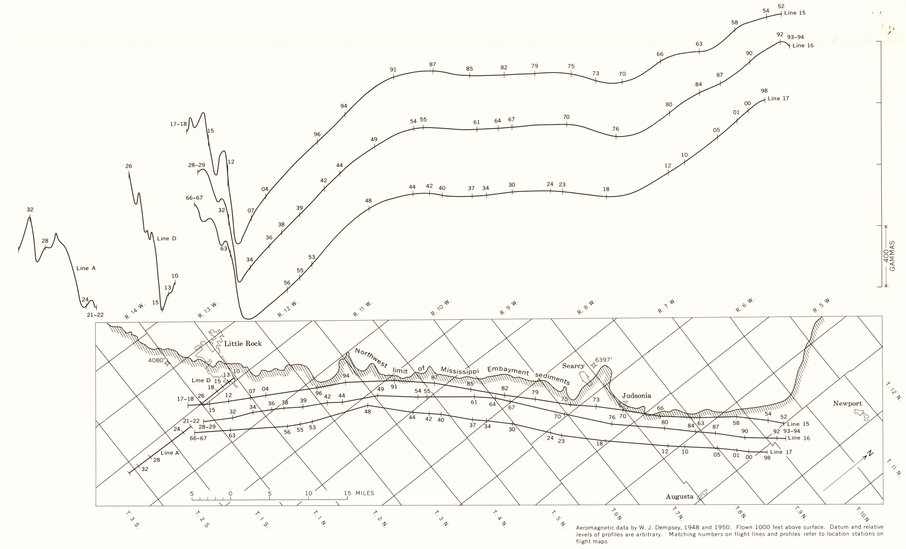
NOTE

Aeromagnetic data are obtained and compiled along a continuous line, whereas ground magnetic surveys are made at separate points. Errors within the normal limits of any magnetic measurement may cause slight discrepancies between flight lines in an aeromagnetic map, which would be more obvious than similar discrepancies between points in a ground magnetic map. For this reason as much care should be exercised in evaluating magnetic features that appear as elongations along a single aeromagnetic traverse as in interpreting an anomaly indicated by a single ground station

APPROXIMATE MEAN DECLINATION, 1964

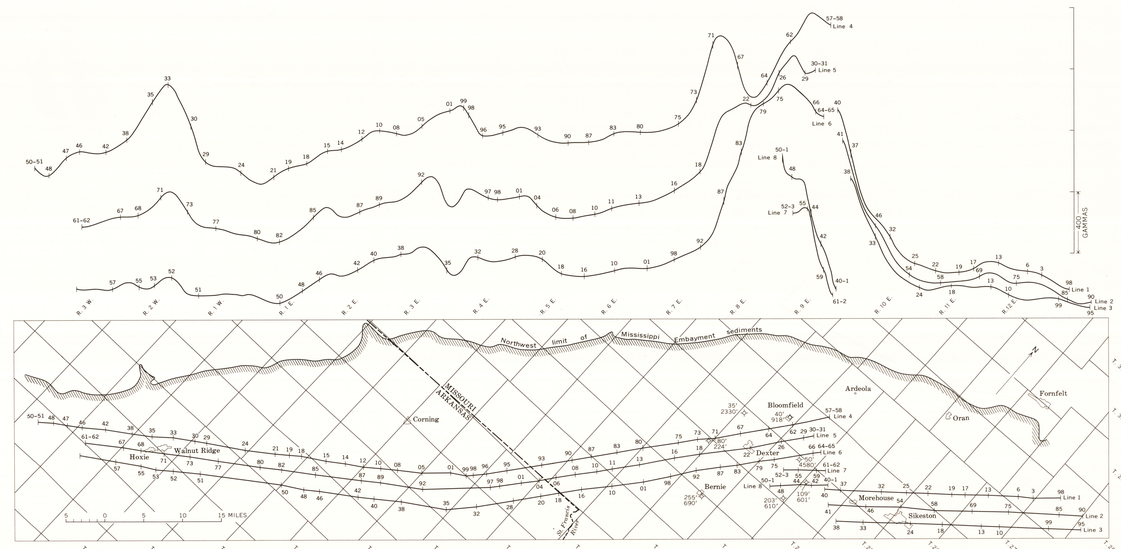


FIGURE–1 INDEX MAP SHOWING LOCATIONS OF DESCRIBED AREAS AND REGIONAL AEROMAGNETIC FLIGHT LINES



Aeromagnetic data by W. J. Dempsey, 1948 and 1950. Flown 1000 feet above surface. Datum and relative levels of profiles are arbitrary. Matching numbers on flight lines and profiles refer to location stations on flight maps

FIGURE–2 TOTAL-INTENSITY AEROMAGNETIC PROFILES FROM LITTLE ROCK NORTHEASTWARD TO NEWPORT, ARKANSAS



Aeromagnetic data by W. J. Dempsey, 1948. Flown 1000 feet above surface. Datum and relative levels of profiles are arbitrary. Matching numbers on flight lines and profiles refer to location stations on flight maps

FIGURE–3 TOTAL-INTENSITY AEROMAGNETIC PROFILES FROM LAWRENCE COUNTY, ARKANSAS, NORTHEASTWARD PAST BLOOMFIELD, STODDARD COUNTY, MISSOURI, TO ALEXANDER COUNTY, ILLINOIS

TOTAL-INTENSITY AEROMAGNETIC MAP OF THE NEWPORT AREA IN PARTS OF INDEPENDENCE, IZARD, JACKSON, LAWRENCE, SHARP, WHITE, AND WOODRUFF COUNTIES, NORTHEASTERN ARKANSAS

SCALE 1:125,000

2 0 2 4 6 8 10 MILES

5 0 5 10 KILOMETERS

CONTOUR INTERVAL 10 GAMMAS

INTRODUCTION

The U.S. Geological Survey in July 1948 made a reconnaissance aeromagnetic survey of a strip 6 miles wide along the west edge of the Mississippi Embayment from Cairo, Ill., southwestward to Little Rock, Ark., a distance of roughly 250 miles (fig.1). This survey included the bauxite area near Little Rock. The purpose of the study was to search for near-surface igneous rocks similar in magnetic expression to the nepheline syenite that has been laterized to form the bauxite deposits at Little Rock. Ground magnetic and gravity surveys of the Little Rock area made during World War II had located unexposed nepheline syenite bodies that were later proved by drilling (Malamphy and Vallely, 1944; Malamphy and others, 1948).

Four magnetically anomalous areas were revealed by the 1948 reconnaissance survey. One is in Stoddard County, southeastern Missouri; the other three are in northeastern Arkansas: near Corning, Clay County; near Walnut Ridge, Lawrence County; and in the vicinity of Newport, where the Ozark Escarpment is abruptly offset from its rather straight northeasterly trend. In 1950 a detailed aeromagnetic survey spanning the boundary between the sediments of the Mississippi Embayment and the older rocks to the northwest was made of the Newport area—about 1400 square miles (Dempsey, 1951). At the same time two additional lines—A and D—were flown in the Little Rock bauxite area (figs. 1 and 2).

Both the reconnaissance and the detailed aeromagnetic surveys were made with a continuously recording AN/ASQ-3A airborne magnetometer installed in a twin-engine aircraft. U.S. Geological Survey topographic maps, U.S. Army Corps of Engineers maps, and Arkansas State Highway Commission county highway maps were used for pilot guidance and for compilation of the magnetic data. The flight path of the aircraft was recorded by a gyrostabilized continuous-strip-film camera, and the distance from plane to ground was measured with a continuously recording radio altimeter. Traverses were flown north-south approximately 1000 feet above the ground, the reconnaissance at 2-mile intervals, and the detailed survey at quarter- and half-mile intervals. All data were compiled as rectified profiles.

GEOLOGIC SETTING

In most of the project area rather flat-lying sedimentary rocks of Paleozoic age are in contact with the younger Mississippi Embayment sediments to the southeast. These sediments range in age from Late Cretaceous to Recent. The Cretaceous sediments are unconformably overlain by Paleocene sediments of the Midway Group; and that group is unconformably overlain by Eocene terrestrial sediments of the Wilcox Formation. The Midway Group and Wilcox Formation are of major importance in this study, as the proved bauxite deposits in the Little Rock area are found at or near their unconformable contact, and new discoveries in the Embayment would be most likely at this stratigraphic horizon.

In the Little Rock bauxite area the Paleozoic rocks are steeply dipping and in places tightly folded and somewhat metamorphosed (Gordon and others, 1958, p. 11-12). A complex group of alkalic igneous rocks of batholitic proportions, including stocks and other bodies of nepheline syenite, were intruded into these Paleozoic beds probably in Late Cretaceous time. Extensive erosion truncated the Paleozoic rocks and exposed the igneous rocks in a series of low hills. No Cretaceous sedimentary rocks are exposed in the Little Rock area, nor were any Cretaceous sedimentary rocks cut by the drill holes of the Bureau of Mines, the deepest of which went to 1500 feet (Malamphy and others, 1948). In Paleocene time a shallow sea occupied the Embayment area, and the Midway marine sediments were deposited in the sea and on the flanks of the hills. The sea withdrew, and in early Eocene time the Wilcox terrestrial deposits were laid down. Laterization of the nepheline syenite, during early Eocene time, provided the material for the bauxite deposits. All of the deposits lie within the Mississippi Embayment, principally on the post-Midway erosion surface. In many places beds of the Wilcox Formation overlie and enclose bauxite deposits on and near the flanks of the nepheline syenite stocks. In other places the bauxite has been transported short distances downslope, but no significant deposits are known more than a mile from the nepheline syenite (Gordon and others, 1958, p. 100).

The reconnaissance flight lines of 1948 followed in a general way the area of outcrop of the Tertiary rocks. Here the unconformable contact of the Midway and Wilcox, which is the stratigraphic horizon favorable to bauxite accumulation, lies close to the surface, and any bauxite discoveries resulting from the survey would be within economic mining depth.

AEROMAGNETIC INTERPRETATION

The magnetic data resulting from the survey are presented as a contoured map on a generalized geologic base for the six-quadrangle area near Newport and as magnetic profiles for the reconnaissance lines northeast and southwest of the Newport area.

The most conspicuous anomalies are (1) in the Little Rock area in central Arkansas; (2) near Bloomfield, Stoddard County, Mo.; and (3) in the Newport area in northeastern Arkansas. Two smaller anomalies can be seen on the profiles shown in figure 3, one about 10 miles southeast of Corning, in Clay County, Ark., and the other some 30 miles farther southwest, at Walnut Ridge in Lawrence County, Ark.

LITTLE ROCK AREA, CENTRAL ARKANSAS

Reconnaissance flight line D from station 15 southward is either above exposed and shallow-buried nepheline syenite or above open-pit bauxite mines (Gordon and others, 1958, pl. 2), and the resulting profile (fig. 2) can be considered a typical magnetic expression of geologic conditions favorable for bauxite. The abrupt break in the profile near station 15 coincides approximately with the mapped north boundary of the buried nepheline syenite and is interpreted to mark the steep north boundary of the igneous body.

The steepest gradient on reconnaissance profile A, near station 32 (fig. 2), coincides with a magnetic high shown by Malamphy and others (1948, figs. 13 and 16). Drilling in this area found ultramafic igneous rock at a depth of 1450 feet (Malamphy and others, 1948, p. 40). The high on profile A near station 28 is caused by nepheline syenite that was found by drilling to lie 600 to 1200 feet below the surface. This was below the Midway Group and therefore is nonbauxitic. A depth calculation based on the steepest part of profile A gives a figure of 850 feet below the surface, which is in good agreement with the drilling data.

The southern ends of reconnaissance profiles 15, 16, and 17 are similar to profiles A and D and are interpreted as typical magnetic expressions of nepheline syenite in this area. In fact, mapped subsurface nepheline syenite underlies parts of profile 15 from a mile north of station 12 to a mile south of station 15 (Gordon and others, 1958, pl. 2). Profiles 16 and 17 lie outside the area mapped by Gordon and others, but estimates of depths to the nepheline syenite near stations 32 and 63, respectively, based partly on the method of Vacquier and others (1951) and partly on a comparison of the profiles with profile 15 near station 12, indicate burial of only a few hundred feet. Estimates of depth to the Midway Group near these same stations, based on a southeastward continuation of the slope of the post-Midway erosion surface as shown on Gordon's plate 2 (Gordon and others, 1958), are somewhat greater. It therefore is possible that in this area the nepheline syenite may extend above the post-Midway erosion surface. Further prospecting for bauxite reserves might be warranted; post-Eocene erosion, however, may have stripped away the bauxite deposits in this area (Gordon and others, 1958, p. 170). These estimates represent the situation in T. 1 N., R. 11 W., outside the area drilled by Malamphy and others (1948).

The abrupt change in character of the three profiles a short distance northeast of stations 12, 32, and 63 is not unlike the change of profile D near its station 15, which is approximately at the north boundary of the mapped subsurface nepheline syenite. The abrupt change in profiles 15, 16, and 17 is interpreted as marking the easterly continuation of the steep north boundary of the igneous mass, thus corroborating the limit inferred by Gordon and others (1958, pl. 5).

Northeastward from this abrupt change, profiles 15, 16, and 17 show the magnetic characteristics interpreted as associated in this area with the Precambrian crystalline basement.

A gravity anomaly outlines the igneous rocks of the Little Rock area (Lyons, 1961, p. 95). The other magnetic anomalies in the project area in Arkansas have no marked counterparts in the gravity expressions, although a minor gravity high appears to be associated with a magnetic anomaly in the Newport area.

BLOOMFIELD AREA, STODDARD COUNTY, MO.

In the Bloomfield area (fig. 1) the Midway-Wilcox contact is at or only a few hundred feet below the surface. The segments of the eight profiles (fig. 3) in the vicinity of Bloomfield yield depths of 4100 to 9000 feet, as determined by the method of Vacquier and others (1951). A median depth of about 6500 feet is probably the most realistic. The deepest well in the area, in sec. 3, T. 25 N., R. 11 E., entered Cambrian rocks at 2750 feet and bottomed in Upper Cambrian rocks (Lamotte Sandstone) at 4580 feet.

Assuming that Middle and Lower Cambrian strata are missing in southeast Missouri (Grohskopf, 1955, pl. 9), it is reasonable to conclude that the subsurface magnetic body is part of the Precambrian crystalline basement. It is unlikely that the reconnaissance lines flown at 2-mile spacing and the State ground magnetic survey made at 1-mile spacing have missed any near-surface magnetic bodies. The source of bauxite boulders found at the Midway-Wilcox contact near Ardeola, 9 miles northeast of Bloomfield, remains undiscovered. If the bauxite, as suggested by Stewart and others (1948, p. 17), has its source in chemically weathered and leached Porters Creek Clay of the Midway Group, no magnetic expression of the associated rocks can be expected.

The most intense gravity anomaly in Missouri coincides with the magnetic anomaly in the Bloomfield area. The high density and high magnetic susceptibility of the rock mass causing these anomalies indicate that it is probably a large mafic intrusion. Missouri Geol. Survey, 1943.

NEWPORT AREA, ARKANSAS

The large area and regular shape of the anomalies near Newport are characteristic expressions of rather deeply buried crystalline rocks. The anomaly just southwest of Newark represents a mass about 7 miles wide, 14 miles long, and buried about a mile below the surface. (See Vacquier and others, 1951, model fig. A75, p. 139). A gravity high of about 10 milligals is associated with this magnetic feature. The location of the maximum of this magnetic anomaly in the reentrant in the Ozark Escarpment suggests that the underlying rock mass is related in some way to the structural feature that resulted in the reentrant and that determined the course of the White River in this area.

The high in the north-central part of the map area is underlain by a rock mass about 2 miles wide, 10 miles long, and buried a little less than a mile below the surface. (See Vacquier and others, 1951, fig. A73, p. 137). The apparent susceptibility of this mass is similar to that of the other anomaly.

Several wells in the Newport area reach depths within a few hundred feet of the calculated depths to crystalline Precambrian bedrock, but none of them penetrate the basement. A well in the southwest corner of T. 10 N., R. 3 W., is reported to bottom at 5007 feet in limestone of Early Ordovician age; one about 6 miles farther south, in T. 9 N., R. 3 W., is reported to bottom at 6002 feet in sedimentary rocks of Early Ordovician age; and one in the south-central part of T. 8 N., R. 7 W., White County, bottoms at 6397 feet in Ordovician rocks (Oil Weekly, 1945, p. 124).

CORNING AREA, CLAY COUNTY, ARK.

The small magnetic anomalies on lines 4, 5, and 6 east of Corning (fig. 3) are probably caused by changes in magnetic susceptibility in the basement complex. A determination of depth to the basement, based on the steep-gradient segment of line 5 just northeast of station 92, indicates 5000 to 5500 feet. A 400-gamma anomaly about 3 miles west of Corning was discovered a few years ago by a single cross-country aeromagnetic flight line from New Orleans, La., to St. Louis, Mo. (E. R. King, oral communication, 1961).

WALNUT RIDGE AREA, LAWRENCE COUNTY, ARK.

An analysis of the anomaly on the profile of flight line 4 (fig. 3) in the vicinity of Walnut Ridge yields a depth for the subsurface magnetic body of about 8200 feet. Profiles of lines 5 and 6 at this point are too irregular in shape for analysis, and a depth determination based on a single profile may be too large. Nevertheless, this depth is not inconsistent with depth to basement in the other anomalous parts of the project area.

CONCLUSIONS

None of the magnetic data outside the Little Rock area indicate igneous rocks near enough to the surface to be possible sources of bauxite. The magnetic highs throughout the area between Cairo, Ill., and the nepheline syenite body at Little Rock, Ark., are considered to be expressions from Precambrian crystalline basement. The magnetic lows are either the normal lows that appear north of highs in the earth's magnetic field in the Northern Hemisphere or they represent rocks of lower magnetic susceptibility than that of the surrounding rocks.

The calculated depths to the top of the crystalline basement suggest that the Middle and Lower Cambrian strata, if present, are very thin.

The only place in the entire project area where the magnetic data indicate conditions that might be favorable for bauxite accumulation is T. 1 N., R. 11 W., a few miles southeast of Little Rock.

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